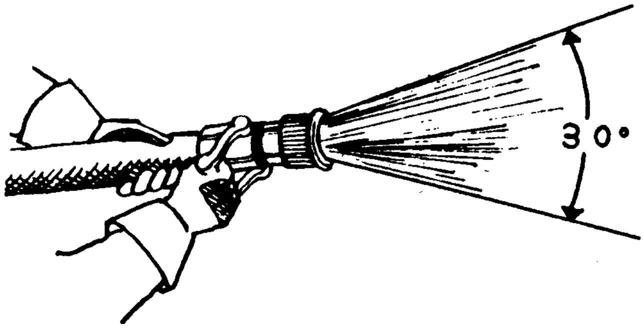


Figure 2-22. Measuring the angle of a fog stream.

water. Fog nozzles may produce a fixed fog pattern, or the pattern may be adjustable from a straight stream (which is not a solid stream) to a wide angle fog of nearly 180 degrees. The angle of a fog stream is the approximate angle formed from one edge of the stream to the other (fig. 2-22). Nozzles are available that discharge an almost constant volume of water as fog patterns are changed. Others will discharge varying volumes of water depending on the pattern. Still others have selectors to change the volume of discharge, with the discharge remaining almost constant as patterns change at a given setting.

b. Solid Stream Nozzle. The solid stream nozzle (fig. 2-23) normally consists of an open tip, a controlling shutoff, and a playpipe with handles to make controlling the nozzle easier. The volume of water discharged at a given pressure depends on the size of the tip. Tips are usually interchangeable to obtain different volume discharges. This is an aid if the water supply will not provide an effective stream with the larger size tips. The purpose of a solid stream nozzle is to project water so that it will travel a distance or will penetrate through loose or porous material. Effectivness of the nozzle depends on a smooth surface in the tip, so care must be taken not to drop or otherwise dent or damage the tip. Design of the solid stream nozzle produces a thrust backward on the nozzle and hose when it is used. It is important to be prepared for this reaction when using this type of nozzle.

c. Combination Nozzle. The combination nozzle (fig. 2-24) has both a fog tip and a solid stream tip. The controlling shutoff has positions for both fog stream and solid stream operation, as well as an off position. It should not be used on electrical or flammable liquids fire because the control handle might accidentally be shifted to the solid stream position.

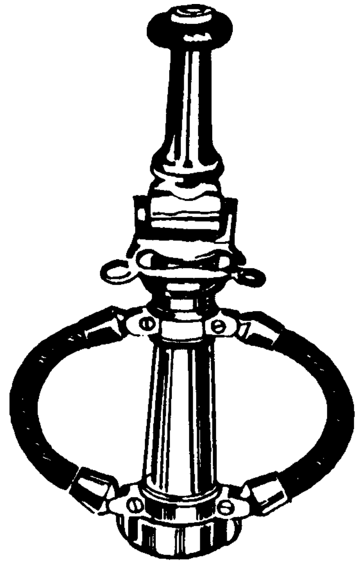


Figure 2-23. Solid stream nozzle.

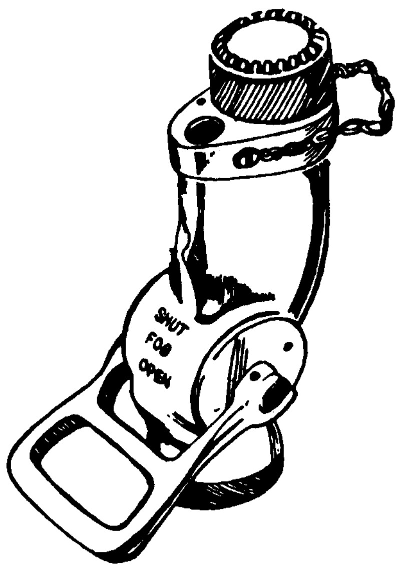
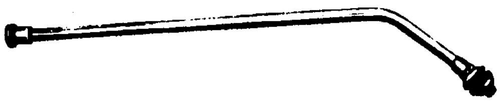


Figure 2-2.4. Combination nozzle.

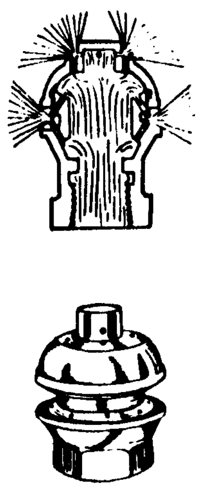
d. Applicators. An applicator (fig. 2-25) consists of a controlling shutoff, a pipe 2 to 10 feet (0.6 to 3 meters) long, often bent at a 45 or 90 degree angle at the tip end, and a tip which may be of the solid stream, high velocity fog, or low velocity fog type.

(1) *Low velocity fog tip.* This is an impinging stream nozzle or head (fig. 2-25) in which the streams join (impinge) *outside* the head, producing a cloud of fog in the vicinity of the tip, as compared to a fog stream which projects out from the tip.

(2) *Puncture nozzle.* This is a pointed, hardened steel nozzle (fig. 2-26). This nozzle can be



LOW VELOCITY FOG APPLICATOR.



LOW VELOCITY FOG TIP.

Figure 2-25. *Low velocity fog tip and applicator.*

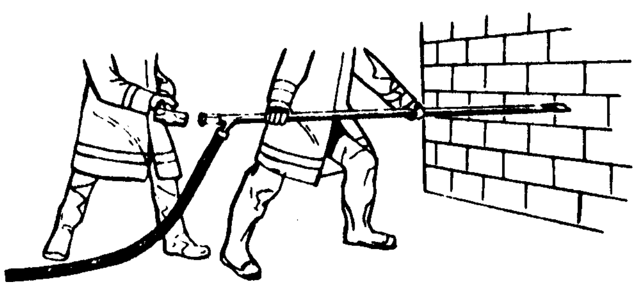


Figure 2-26. Puncture nozzle.

driven through walls and siding, or into loose material such as baled fibers. A place is provided near the base of some puncture nozzles so they can be driven in with a flathead axe or similar tool.

(3) ***Partition nozzle.*** The partition nozzle (fig. 2-27) discharges a solid stream at a 90° angle to the pipe, with the direction of the stream controlled by a handle. The partition nozzle often has a pointed projection near the tip to aid in pushing it into a wall, though materials through which it can be driven are more limited than with the puncture nozzle.

e. Distributor and Cellar Pipe.

(1) ***Distributor.*** A distributor (fig. 2-28)

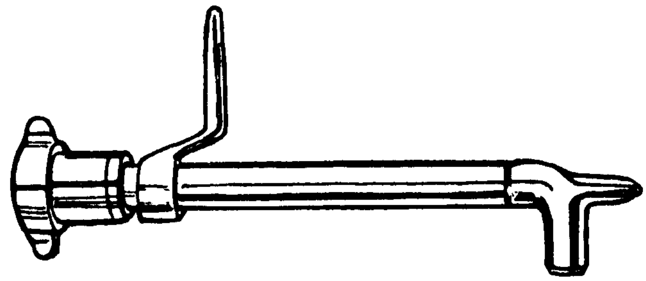
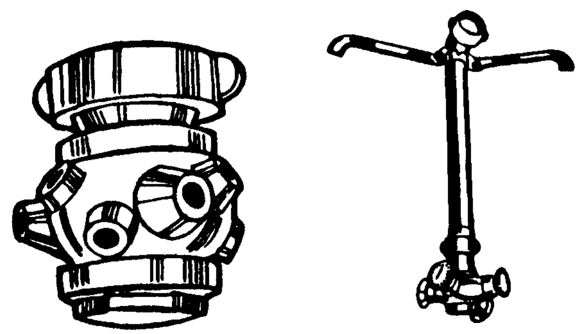
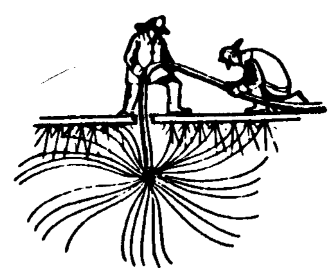


Figure 2-27. *Partition nozzle.*



ROTATING **DISTRIBUTORS**



ROTATING DISTRIBUTOR IN OPERATION

Figure *2-28. Distributors.*

consists of a swivel with an arrangement of straight or fog tips. The reaction of the tips causes the swivelled head to rotate rapidly. This throws a spray in a spherical pattern around the distributor. It is useful for attacking fires that cannot be reached by other means. Before the device is put in operation a controlling shutoff must be placed in the line so that the distributor can be shut down before removing it.

(2) *Cellar pipe.* The cellar pipe (fig. 2-29) consists of a short pipe with one or two straight tips and levers to control the direction of the stream or streams. Cellar pipes are used in the

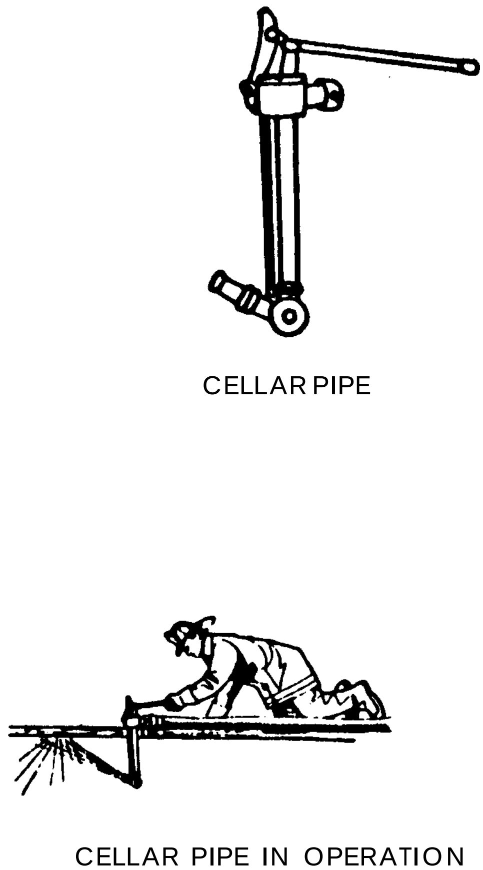


Figure 2-29. Cellar pipe.

same manner as distributors but have greater reach. They also require a controlling shutoff like the distributors.

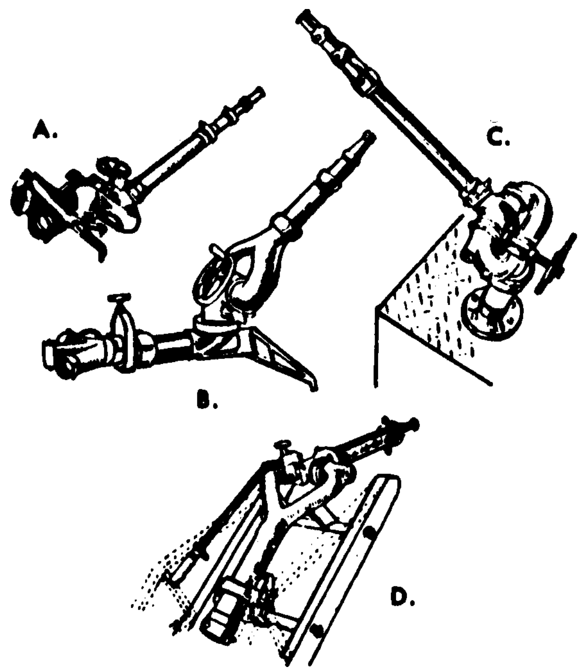
*f. **Master Stream Devices.*** Basically, a master stream device (fig. 2-30) consists of a siamese or manifold arrangement for collecting water from more than one line of hose and for mechanically directing the stream and the nozzle tip. Tips are removable so that the proper type and size can be used for a particular situation. A length of pipe called a ***stream straightener*** is used with solid stream tips. It contains thin baffles or vanes to keep the large volume of water from swirling and breaking up the stream. A ***monitor nozzle*** is used from the ground and can be mounted for use on an engine. A ***deluge set*** is an older version of the monitor nozzle. It consists of separate parts joined by a large diameter pipe or hose. It normally is not mounted on an engine because its rotation would be limited. The ***deck pipe*** is mounted on an engine, connected directly to the pump by piping. It may also be connected to siamese inlets mounted permanently on the engine or truck. A ***ladder pipe*** is attached to an aerial ladder, It is supplies by a large diameter hose with the Siamese on the ground. Some ladder pipes are mounted permanently on the bed section of an aerial ladder. All master stream devices have controls to govern the vertical direction of the stream. The monitor nozzle and deck pipe have horizontal direction controls as well. Some ladder pipes and deluge sets have controls to permit limited horizontal movement of the stream. A ladder pipe should be moved horizontally by rotating the ladder. This avoids placing dangerous stress on the ladder.

*g. **Sprinkler Heads.*** Heads on sprinkler systems (fig. 2-31) in structures act as metering devices. They give the advantage of applying water in the fire area without sending men into it. Fire departments must supply such systems with hose lines from engines to assure adequate volume andpressure of water.

2-10. Devices Which Control Flow

The following are in-line valves which control the flow of water through hose lines:

*a. **Ball Valves.*** The ball valve (fig. 2-32) consists of a housing with couplings, a ball with a waterway through the middle, and a handle to



A. MONITOR NOZZLE B. DELUGE SET
C. DECK PIPE D. LADDER PIPE

Figure 2-30. Master stream devices.

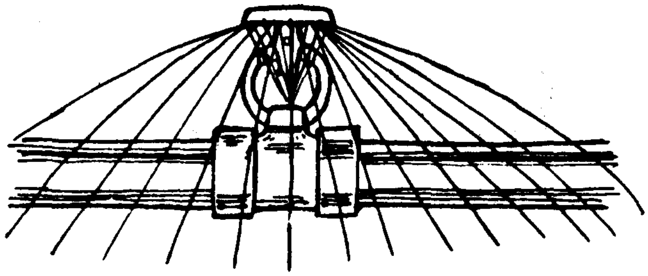


Figure 2–31. Sprinkler head discharging.

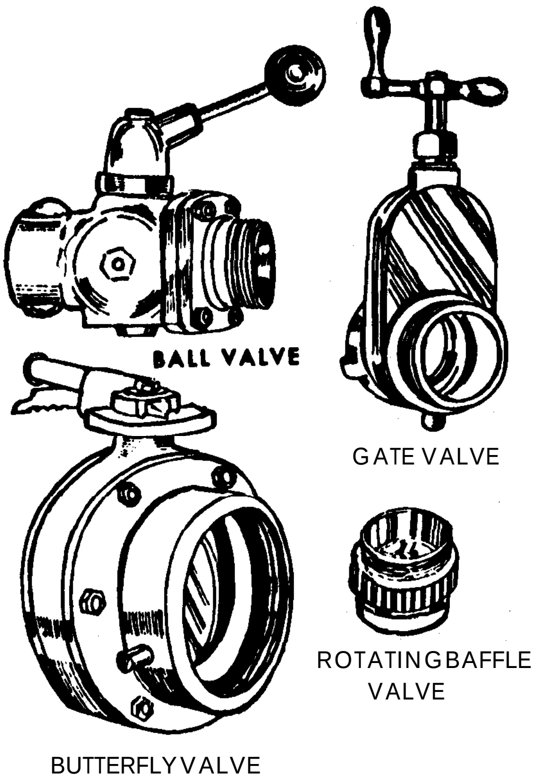


Figure 2–32. Devices that control flow.

turn the ball. In most models, when the handle is turned in line with the hose line the valve is open. Turning the handle to a right angle to the hose line, or to a right angle to the open position, rotates the ball and shuts the valve, Earlier versions have a cylinder in place of the ball.

b. Gate Valve. The gate valve (4ig. 2-32) has a housing with couplings and a baffle, or solid plate which is operated by a handle and screw arrangement. Turning the handle *moves* the baffle down into (or up out of) the waterway.

c. Butterfly Valve. A butterfly valve (fig. 2-32) or keystone type valve consists of a housing with couplings, and a baffle or plate connected to a quarter turn handle. It operates in the same way as the ball valve, except that the flat baffle instand of a ball with a waterway forms the shutoff. The chief advantage of the butterfly valve is ease of maintenance and repair.

d. Rotating Baffle Valve. Rotating baffle valve (fig. 2-32) consist of two baffles, each with two open 90-degree segments. Turning one of the baffles to line up its open segments with those in the second opens the valve. Turning it to line up its open segments with the closed segments in the second baffle closes it. This type valve is also known as the “gizmo”.

2-11. Devices That Combine or Divide Flow

The following are combining or dividing devices used by firefighters:

a. Wyes. A wye (fig. 2-33) divides a hose line into two lines of the same or smaller size. If it has controlling valves (gate or ball valve), it is known as a *gated wye.* Most controlling valve wyes today are manufactured with ball type valves, If the wye divides the line into smaller lines it is called a ***reducing wye*** or ***gated reducing wye.*** The gated reducing wye which divides a 2½-inch (6.35-centimeter) hose line into two 1½-inch (3.8-centimeter) lines is very common.

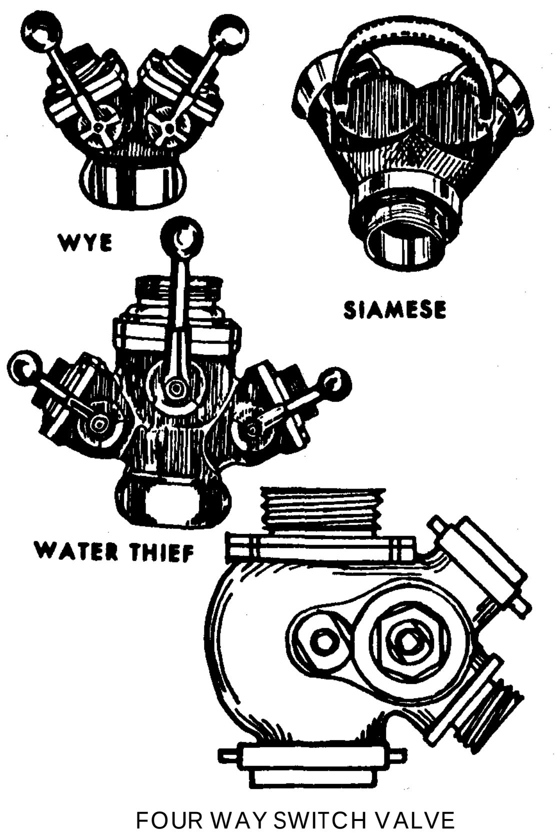


Figure 2–33. Combining and dividing devices.

b. Siamese. The siamese is a Y-shaped connection (fig. 2-33) which combines two ormore hose lines into a single line of the same or larger size. It is used primarily to join two 2½-inch (6.35-centimeter) intake lines into a single 2½-inch (6.35-centimeter) outlet line or into other heavy stream appliances. Siamese may have swing check valves (clapper valves) to assure that water will not flow back through any of the inlets, and are then called *clapper valved siamese.* They may have gate or ball valves called *gated siamese.* A siamese that combines from two to four small lines into a single larger line is known as an *increasing siamese.* The gated increasing siamese is often carried on the large steamer inlet of a pumping engine and is also known as a *suction siamese.*

c. Water Thief. The water theif (fig. 2-33) has a 2½-inch (6.35-centimeter) inlet and two gated 1½-inch (3.8-centimeter) discharges, as well as a 2½-inch (6.35-centimeter) discharge which may or may not have a controlling valve. It is used for taking short attack lines from a 2½-inch (6.35-centimeter) or B-inch (6.6%centimeter) supply line.

d. *Four-Way Switch Valve.* The four-way switch valve (fig. 2-33) is used to hook up a supply line to a hydrant. It permits hooking. up a pumping engine to the hydrant later, without shutting down the supply, and then increasing water pressure in the supply line .This is done by moving a single rotor or two baffles, depending on the design of the valve, so the path of the water is changed from the supply line to the engine and back through the supply line.

2–12. Adapters for Coupling

Adapters are used for coupling hose which cannot be joined because of a difference in coupling size, threads, or the fact that both are male or female.

a, *Adapter.* True adapters permit joining couplings with unlike threads. The rigid adapters consist of a short tube with one type of thread on the female end and the other type on the male end, The adjustable adapter (fig. 2–34), such as the universal and automatic types, normally have a male coupling thread which matches the department's standard thread on one side and teeth on the other side. The teeth adjust over the male hose coupling, either by spring action or manual lever operation, engaging the male threads. A twist of the hose coupling tightens the connection.

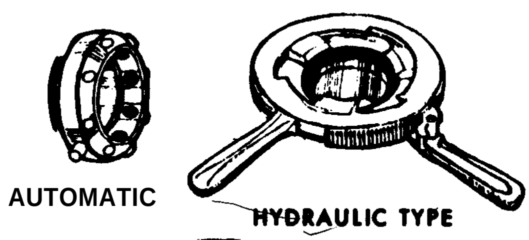


Figure 2–34. Adjustable adapters.

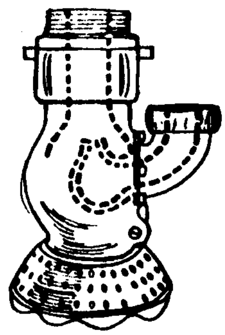


Figure 2–35. An eductor.

b. Reducers and Increasers. Reducers and increasers are used to join different size hose couplings. The reducer is a rigid adapter with a large female thread on one end and a smaller size male thread on the other. The increaser is a rigid adapter with a small female and larger male thread. Double female reducers equipped with a swivel on the smaller end are used with sleeves.

2-13. Eductors

An eductor (fig. 2-35) is a device that introduces liquid or powder into a water stream by a jet or venturi effect. The waterway coming into the eductor reduces in size to form a nozzle which is directed into a larger opening on the discharge side. The action of this jet creates a siphon effect which is used to pick up foam liquid, chemical foam powder, or other chemicals to be added to the stream. Specially designed siphoneductors are also used to pick up water when a pump cannot or should not be used to draft the water directly.

2-14. Tools

The following are the major tools used to aid in working with hose and appliances:

a. *Tools for Working with Hose and Appliances.* Tools which aid in working with hose and appliances include spanner wrenches, hydrant wrenches, and drafting sleeve mallets. *Spanner wrenches (fig. 2–14)* are used to break couplings,

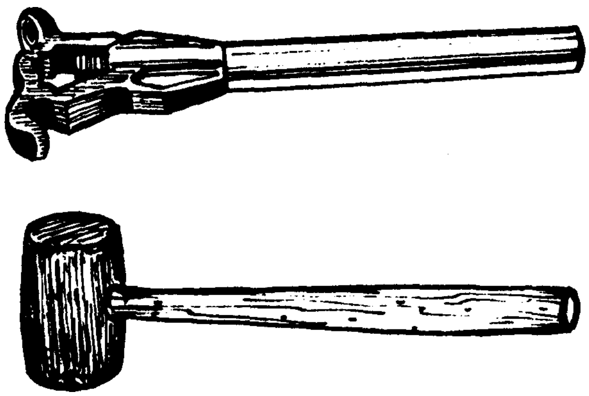
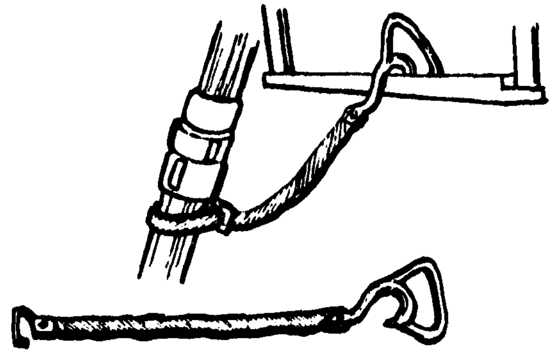


Figure 2–36. Hydrant wrench and rubber mallet.

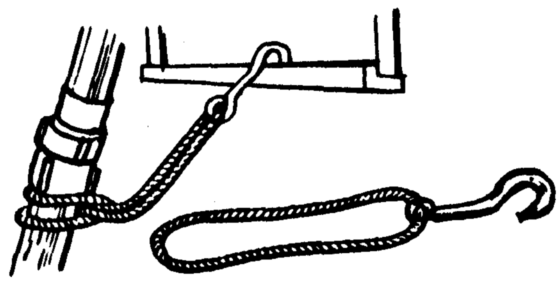
which, with the exception of drafting sleeves, are made up handtight. ***Hydrant wrenches (fig. 2-36)*** consist of long handled box wrenches. Some types have an adjustable box to permit its use on hydrant operating nuts of different size. Some have ears to permit use as a spanner. The hydrant wrench is used to remove hydrant caps and to operate the hydrant operating nut which controls the flow of water from the hydrant. It is also used to operate the valves on some models of four-way switch valves. The adjustable pipe wrench is not normally used to turn a hydrant operating nut because it will damage the nut. It is used, however, if a hydrant with a damaged or missing nut must be used at a fire, as the hydrant must be repaired anyway. ***Drafting sleeve mallets (fig. 2-36)*** have a hard rubber or wooden head. They are used to tap the couplings on drafting sleeves to secure an air tight seal. Mallets must be used with restraint to avoid damaging couplings.

b. Tools For Moving or Securing Hose Lines. Tools which aid moving or securing hose lines include hose straps and rope hose tools, the hose holder (fig. 2–37), and the hose hoist or roller (fig. 2-38). The ***hose holder*** is a device which clamps around the hose line, or has the line threaded through it, behind the nozzle. It enables one man to control a hose line discharging a large volume of water by directing the back thrust or nozzle reaction against the ground. The ***hose hoist*** or roller is used as a bearing for hoisting hose or tools to a roof or upper floor.

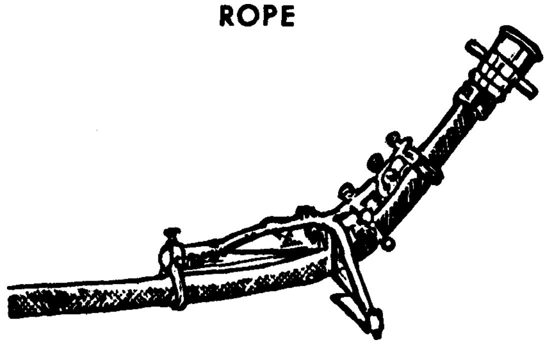
c. Tools For Protecting or Repairing Hose and ***Couplings.*** Tools to protect or provide emergency repairs for hose and couplings include hose jackets, hose ramps, and chafing blocks. The ***hose jacket (fig. 2–39),*** not to be confused with the fabric jacket of hose, is a metal device consisting



STRAP



ROPE



HOLDER

Figure 2–37. Hose securing took.

of two half cylinders hinged on one edge, with a latch on the other. While it does not permanently repair faulty hose, it repairs leaks and tends to prevent additional damage to hose from the effect of water pressure on a hole or tear. The hose jacket can also be used to join lengths of hose with defective, mismated or different couplings, by placing the couplings in the jacket.

d. ***Hose Clamps.*** Several kinds of hose clamps are available. Those in general use are the lever operated devices with latches, screw-down or gate types, and hydraulically operated types (fig.

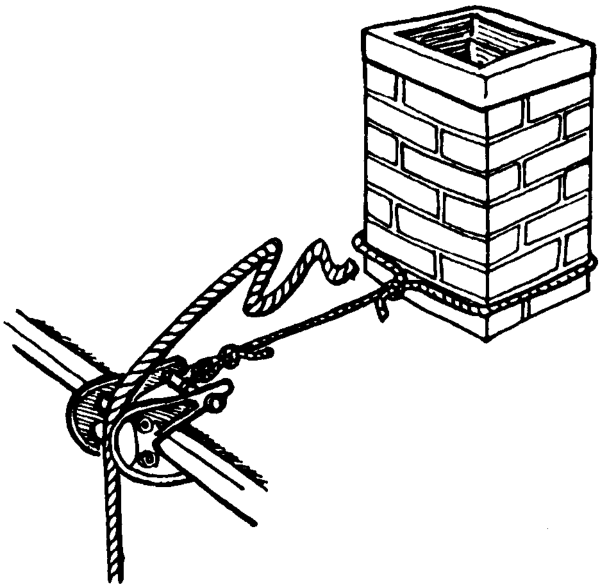


Figure 2-38. Hose hoist.

2-40). All work on the principle of using mechanical force to compress the jacket of the hose together, and stop the flow of water in a line. To operate the lever type, open the clamp, place the hose line between the jaws, and either lift up or press down on the lever. A ratchet type latch will hold the jaws in the closed position. To release, ***stand clear of the lever,*** hold it, down, or up, securely, and release the latch. Release the lever slowly. The lever may tend to kick out with some force when the latch is released. The screwdown or gate type is operated by placing the hose in the jaws and operating as with a gate valve. Hydraulic hose clamps are operated by placing the hose in the jaws, setting the selector to "close" with the wrench end of the operating handle, inserting the handle in the pump lug, and pumping the jaws closed. To release the clamp turn the selector to "open". Push the jaws to the full open position,

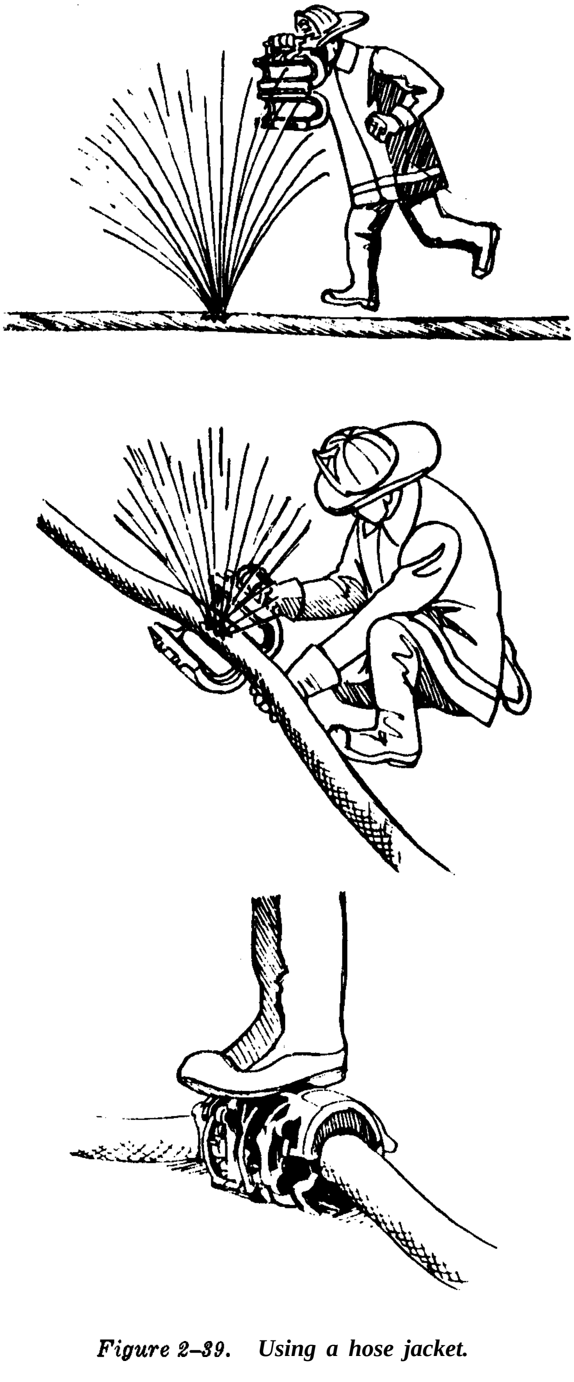


Figure 2-39. Using a hose jacket.

2-15. ladders

Ladders are vital during an emergency, when every second is a factor toward the success or failure of an operation. Firefighters must know the proper procedures for carrying, raising, and climbing ladders so thoroughly that they can do them almost by habit. Even after the procedures are well established in the minds of the trainees, constant practice is essential to maintain this degree of efficiency. Continuous training should be carried on to make these operations as nearly automatic as possible.

a. The standard ladders used by the Army consist of solid beams with cylindrical rungs set in the center of the beam. The following terms are commonly applied to ladders: ***bed ladder,*** the lowest section of an extension ladder; ***fly ladder,*** the top sections of an extension ladder; the ***butt,*** the ground end of the ladder; the ***heel,*** the extreme ground end of the ladder; the ***halyard,*** or ***fly*** rope, used for raising the fly ; and the ***pawl,*** or ***dog,*** the mechanism on the lower end of the fly which locks it to the bed ladder. The heel portion of portable

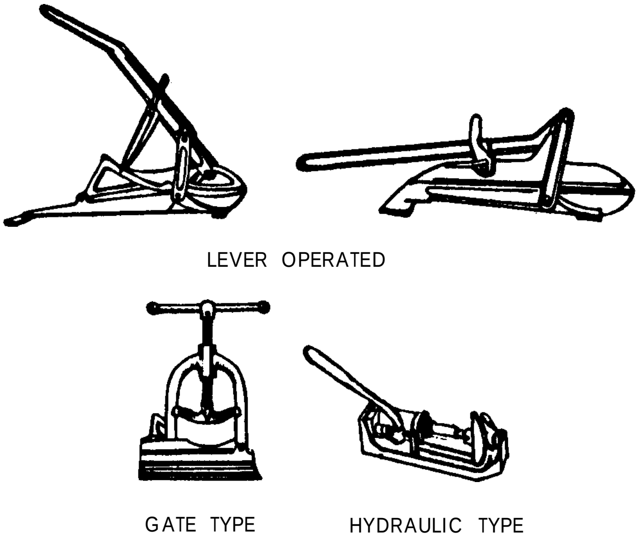


Figure 2-40. Hose **clamps.**

ladders should be equipped with cleats or nonskid footers.

b. The most common ladder in the Army fire-fighting system is the 35-foot (10.7-meter) extension ladder. An extension ladder consists of a bed ladder and one or more fly ladders. The fly ladder, sliding through guides on the upper end of the bed ladder, contains locks which hook over the rungs of the bed ladder. This secures it in position at the desired length of the ladder. The fly is usually raised by a halyard fastened to the lower rung and operating over a pulley on the upper end of the bed. The 24-foot (7.3-meter) extension ladder is commonly found on pumpers.

c. Straight ladders or wall ladders contain only one section, and usually are from 12 to 16 feet (3.66 to 4.88 meters) long. The most common size straight ladder is the 14-foot (4.27-meter) length. The roof ladder is a wall ladder adapted for a special purpose. Roof ladders have hooks mounted on a movable socket that permits the books to fold inward when not in use. Placing the hooks over roof peaks, sills, walls, or the coping of any opening makes the ladder safe and reliable even if the butt does not rest on a foundation. The roof ladder may be used as a wall ladder when the hooks are set so they do not extend beyond the ladder beams. The roof ladder is used when the pitch or the material of the roof or bad weather endangers the men moving over it. It is valuable in climbing to the peaks of gabled roofs to remove roofing materials or to cut holes for ventilation and extinguishment. It may also be used to enter scuttle holes or holes cut through flooring, and sidewalk openings.

d. On installations where there are buildings more than three stories high, special 50-foot (15.25-meter) Bangor ladders may be necessary. These ladders may be either strategically located in the area where they are to be used, or sent to the scene of the fire, mounted on special equipment. These larger ladders require more teamwork than do the two-man ladders to place, raise, and lower them quickly and efficiently.

2-16. The Handline

Rope is indispensable in combating fires. The most widely used type of rope is the handline. Handlines are used for hoisting tools to various floors of a structure and for anchoring ladders, charged hose lines, and other accessories to stationary objects. Handlines for hoisting and anchoring should be either $\frac{5}{8}$ or ah-inch (1.6 or 2-centimeter) rope of 100-foot (30.5-meter) lengths, with an eye spliced in one end. For quick use, a handline should be coiled in such a manner that it pays out without tangling, even when dropped from the top of a building.

a. *Coiling a Handline.* For coiling a handline, a frame containing two vertical posts about 14 inches (36 centimeters) high and 25 inches (64 centimeters) apart is set up (fig. 2-41). The rope is first wrapped several times horizontally around the upright posts and then wrapped around the horizontal wrappings to secure the rope around the posts. When the opposite end is reached, the horizontal pipe is pulled from the coil. The free end of the rope should be folded and slipped through the end of the coil. The free end will then be slipped through the opposite end of the coil and through the loop, thus pulling the loop tight. Loops should be made large enough for the coil to be loaded over the shoulder.

b. *Knots and Hitches.* Knots and hitches should be capable of quickly and securely serving their intended purpose and of being easily tied and untied in darkness. The rope ends should be whipped (tightly bound) to prevent fraying. Eyes may be spliced in both ends of the rope to speed up tying operations (fig. 2-42). Damaged rope should be replaced rather than spliced.

c. *Clove Hitch.* The clove hitch (fig, 2-43) should be used to tie a line to a handtool such as a pike pole. The clove hitch holds the object securely and will not slip when properly tied. It should be

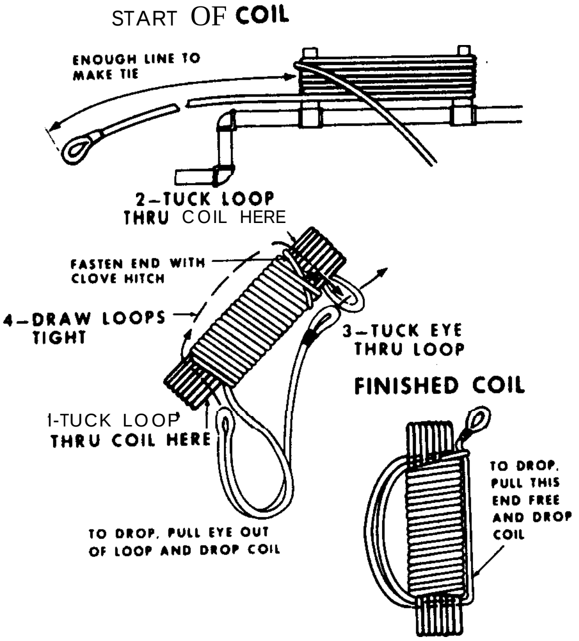


Figure 2-41. **Coiling in** ***handline.***

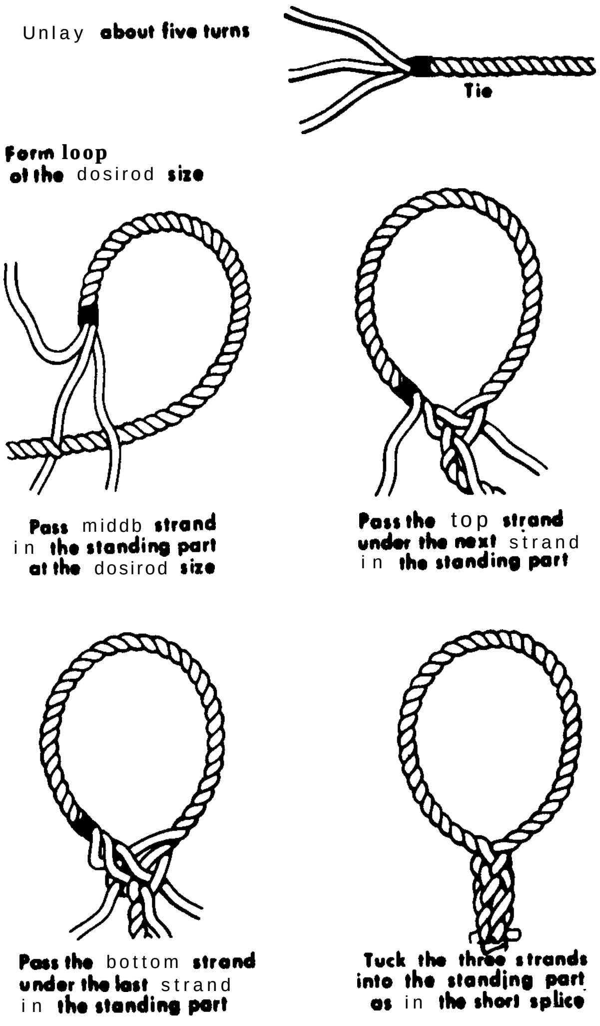


Figure 2-42. ***The eye splice.***

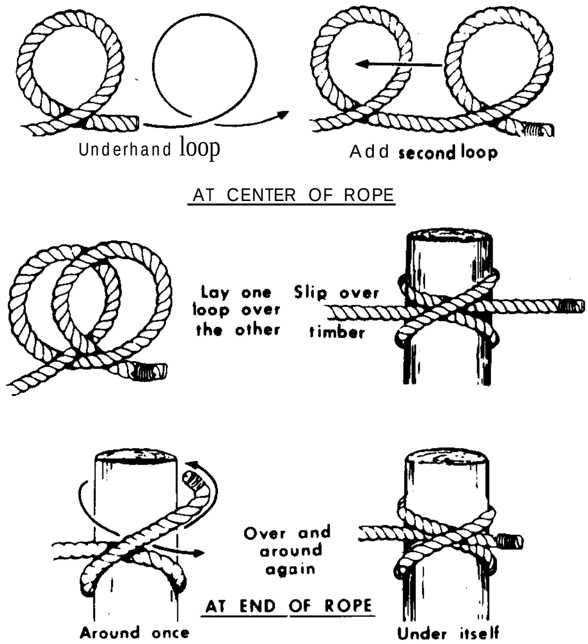


Figure 2-43. The clove hitch.

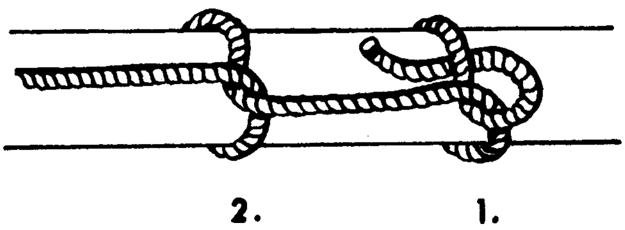


Figure 2-44. The half hitch.

tied near one end of the pole with a single half hitch around the other end.

d. Half Hitch. The half hitch (fig. 2-44) is a loop in a rope which is placed over or around an object so that the standing end of the rope exerts a constant strain on the loop. The running end can be secured under the loop (fig. 2-44) (1)) or may run on to another knot (fig. 2-44 (2)). The half hitch is used with other knots as a safety hitch and to give added stability to objects being hoisted.

e. *Chimney Hitch.* The chimney hitch is used when it is necessary to anchor a rope to a solid object to strengthen the position of another object, such as a charged hose or a ladder (fig. 2-45). The chimney hitch will not slip and is quickly and easily untied. This knot is used when the strain on the rope is to be constant. The rope may be shortened or lengthened by slipping the knot.

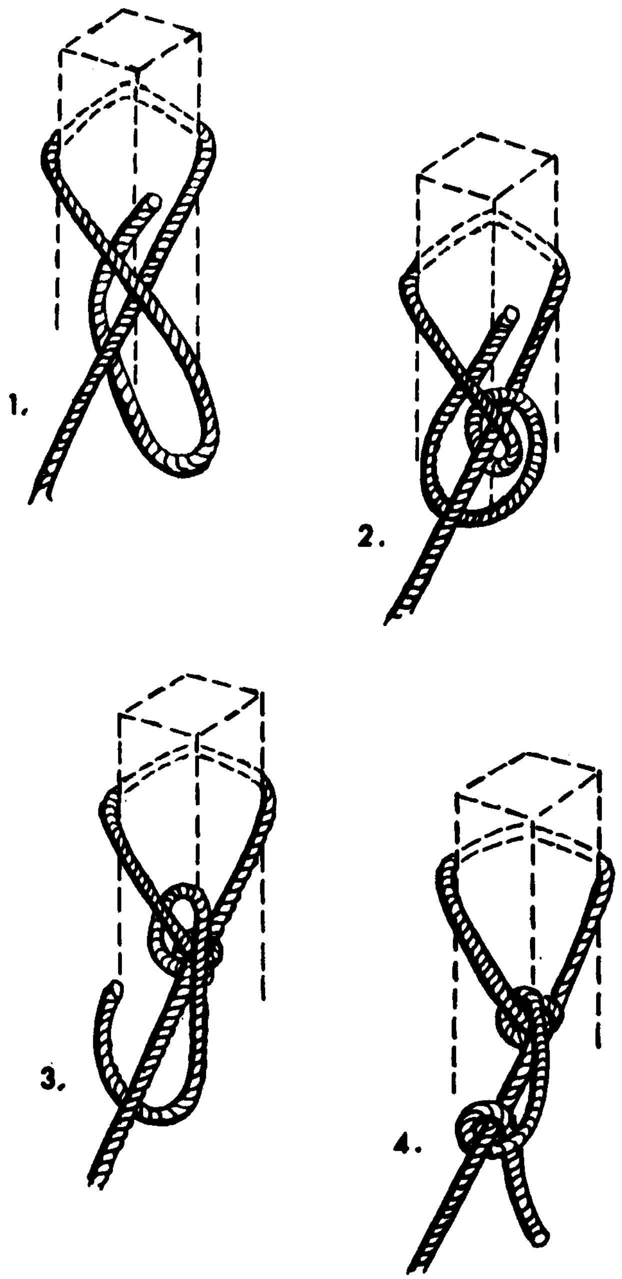


Figure 2–45. The chimney hitch.

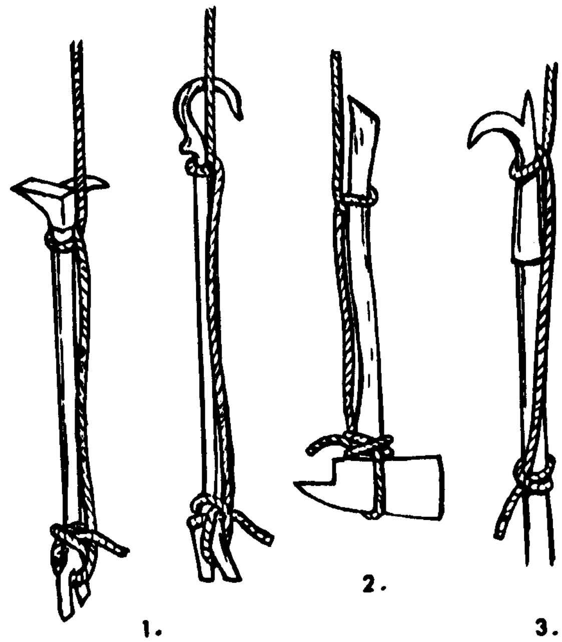


Figure 2–46. Tool hoisting hitch.

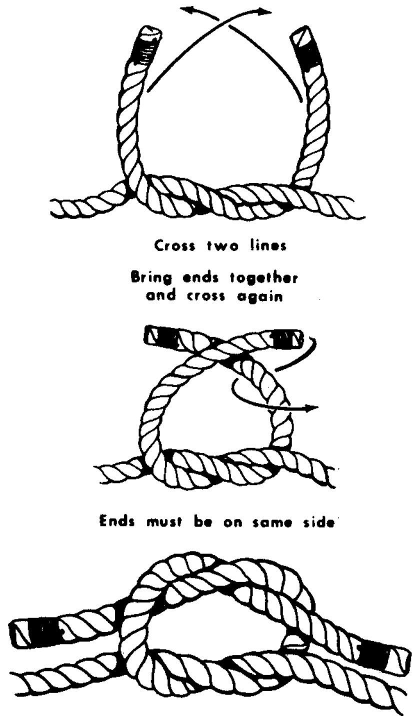


Figure 2–47. The square knot.

*f. **Tool Hoisting Hitch.*** Tools are usually secured by at least two knots (fig. 2-46) to hold them in a relatively stable position. Long heavy tools are generally hoisted with the heavy end up. Tools with hooks or sharp 'projections, such as an ax, are hoisted in a position in which they will not catch on projecting ledges.

g. ***Square Knot.*** The square knot (fig. 2-47) is used to tie the ends of equal sized ropes together.

*h. **Bowline.*** The bowline (fig. 2-48) is a knot that will not slip and is easily and quickly untied. It is used to form a loop on the end of a line. The bowline on a bight (fig. 2-49) is used mainly for rescue purposes.

*i. **Becket Bend.*** The becket bend (fig. 2-50) is used to connect ropes of unequal 'diameter.

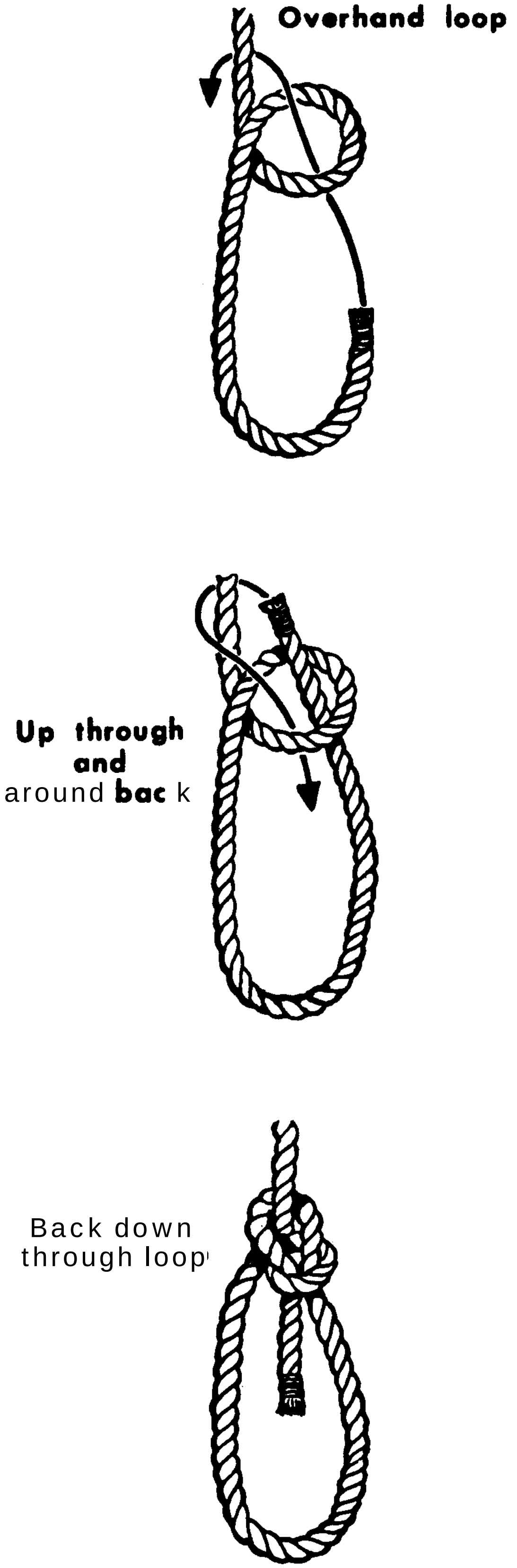


Figure 2-48. The bowline.

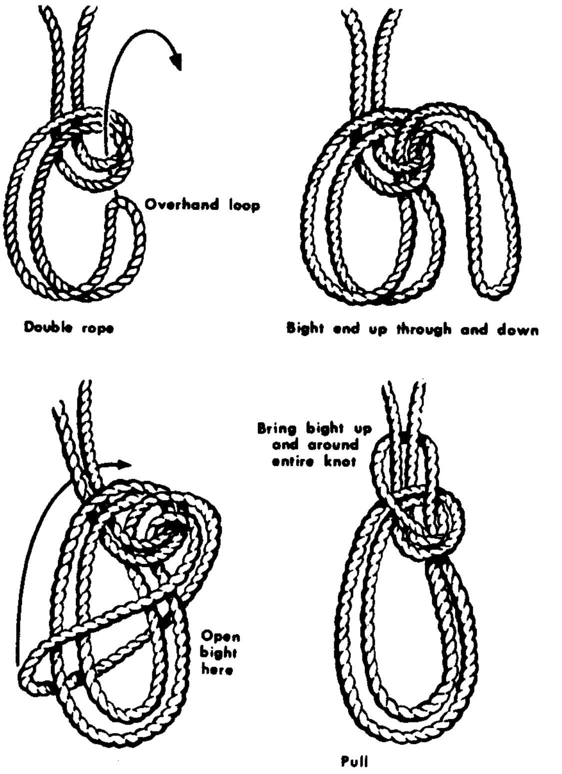


Figure 2-49. The bowline on a bight.

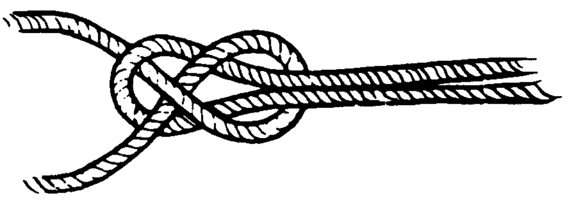


Figure 2-50. The becket bend.

Section IV. FIRE EXTINGUISHERS

2-17. Introduction

Portable fire extinguishers are normally used as first aid firefighting devices for fighting small fires. They often prevent catastrophes. These extinguishers are placed in buildings and other places where there is a fire hazard. Firefighters also carry them on fire apparatus because their extinguishing agents are more effective and better suited under some conditions and for certain materials such as combustible metals. These extinguishers are available in a number of shapes and sizes and contain different agents for various types of fires. The different extinguishers require different individual procedures for inspection, operation, and application. The following are the type of extinguishers most commonly used :

a. Carbon dioxide (CO_2).
b. Pump type water.
c. Pressurized water.
d. Soda-acid.
e. Foam.
f. Bromotrifluoromethane (CF3Br)
g. Dry chemical.

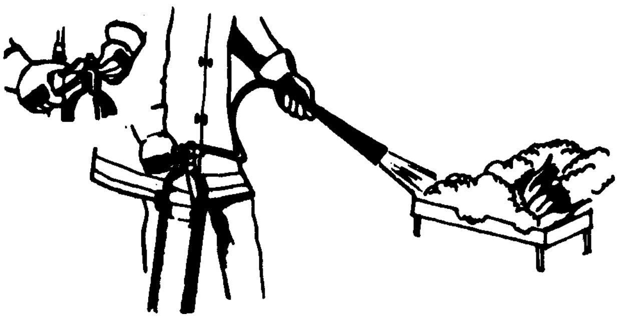
2-18. Inspection

Fire extinguishers must be kept in good operating condition and thus require periodic inspection. When making an inspection of any type of fire extinguisher, take the following action : Examine the surroundings to check that the extinguisher is accessible under actual fire conditions, and that it is not subject to possible mechanical injury. Have all obstructions removed which may hide the extinguisher from view or delay its use. If necessary, change the type of extinguisher or add new units. See that the extinguisher is located in the right place to meet the existing fire regulations. Check the hanging bracket or support for security. Replace, tighten, or strengthen the hanging bracket or support, if necessary, and see that the extinguisher is easily removable.

2-19. Carbon Dioxide Extinguishers

Carbon dioxide CO_2), the extinguishing agent used in the CO_2 extinguisher illustrated in figure 2-51, is a gas about 1½ times heavier than air. It is nonpoisonous, and will not support combustion or sustain life. CO_2 converts to a liquid when under pressure in an individual extinguisher or when refrigerated, as in the bulk storage tank.

a. In operating a CO_2 extinguisher, break the wire seal and remove the safety pin. Hold the extinguisher by the carrying handle in one hand with the thumb or palm resting on the shutoff valve lever. Direct the discharge horn with the other hand, holding the horn by the rubber or wooden handle. Squeeze the shutoff valve lever to operate. Direct the discharge at the base of the fire. On flammable liquids fires, sweep the discharge across the burning surface, starting at the front and working from side to side and front to rear. CO_2 extinguisher discharge valves should be opened fully and the entire contents should be dis-



Pulling the pin, **and discharging the** carbon dioxide Extinguisher.

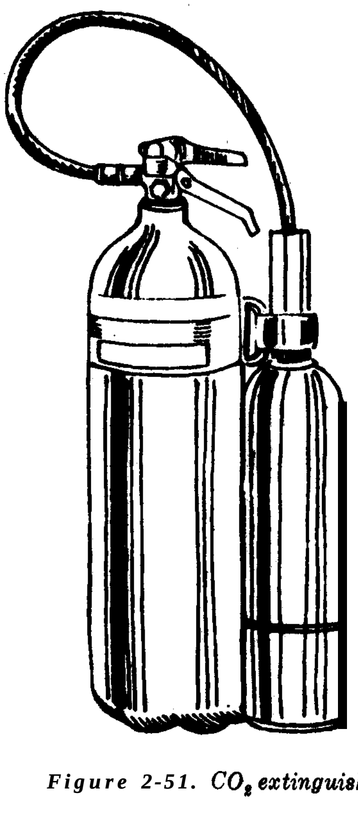


Figure 2-51. CO_2 extinguisher.

charged when fighting flammable liquids fires to give maximum protection against flashback.

b. The CO_2 smothers the fire by cutting off air. The cooling effect is negligible in firefighting.

c. The carbon dioxide extinguisher has an effective range of from 3 to 8 feet (0.914 to 2.44 meters). It must not be stored where temperatures exceed 120° F. (29° C.) as the internal pressure increases in the cylinder. Pressure increases from about 960 psi (67.6 kilograms per square centimeter) at 80° F. (26.7° centigrade) to about 1450 psi (102 kilograms per square centimeter) at 100° F. (38°C). The cylinder contains rupture disks which will rupture at a pressure of between 2400 and 2600 psi (169 and 183 kilograms per square centimeter). Hold the discharge horn only by the insulating rubber or wooden handle. The temperature of the discharging gas is about —110° F. (—79° C) and frostbite can occur from contact with the horn. The horn also builds up a charge of static electricity, particularly with extinguishers having a high discharge rate. Static buildup can be avoided by touching the extinguisher shell to the ground during discharge. Carbon dioxide extinguishers with metal horns are not rated for Class C fires. When operating on a Class C fire be careful to keep the extinguisher shell away from energized electrcal equipment.

d. The CO_2 extinguisher should be recharged after each use. The refill (CO_2) is compressed into the cylinder, usually by a commercial supplier, up to the prescribed full weight.

e. In the monthly inspections, the following is checked: the horn, the discharge hose, the exterior of the shell for defects, and the seal to see if it has been broken. In the annual inspection, the cylinder is weighed in addition to the monthly inspection procedure. If the weight has dropped more than 10 percent of the difference between the full and empty weight, the extinguisher must be recharged. The full weight and empty weight are stamped on the cylinder or shown on a label attached to the cylinder. A hydrostatic test of the cylinder must be performed every 5 years, 12 years if it has not been discharged.

2-20. Pump Type Water Extinguishers

Pump type water extinguishers (fig. 2-52) are the most common type and are made in the $2\frac{1}{2}$-gallon (9.46-liter), 4-gallon (15-liter), and 5-gallon (19-liter) sizes. Almost all of these extinguishers are operated by a hand pump built into the tank. All

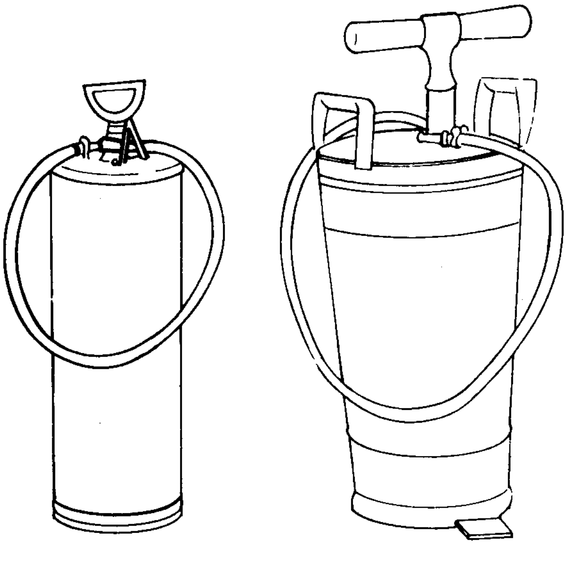


Figure 2-52. Pump type water extinguisher.

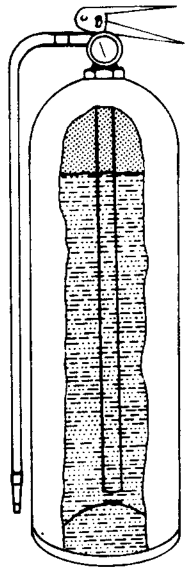


Figure 2-53. Pressurized water extinguisher.

pump type extinguishers are charged with water only, except when they are installed in temperatures requiring the addition of antifreeze compounds. These extinguishers vary in size and shape, but basically all of them operate in the same way and contain a tank, a pump, a hose, and a nozzle. A 5-gallon (19-liter) backpack extinguisher is available for brush or forest firefighting.

2-21. Pressurized Water Extinguishers

Pressurized water extinguishers are one of the new kinds of fire extinguishers. The pressurized water extinguishers used by the Army are of the

2½-gallon (9.46-liter) size (fig. 2-53). The extinguisher consists of a tank, discharge valve, pickup tube, hose and nozzle, and pressure gage. Nitrogen or air pressure of 100 psi (7 kilograms per square centimeter) is used to discharge the water.

a. To operate the pressurized water extinguisher, pull the safety locking pin out, depress the operating handle, and direct the stream at the base of the fire, moving often enough so that as much of the fuel as possible is covered with water.

b. To perform a monthly inspection, check the wire and lead seal for damage, the air pressure gage for deviation from the correct pressure reading of 100 psi (7 kilograms per square centimeter), and the hose and nozzle for foreign objects. The semiannual and annual inspections are similar in scope to the monthly inspection.

c. To recharge the pressurized water extinguisher, first remove the discharge valve and attach the pickup tube. Then fill the tank with 2½ gallons (9.46 liters) of water, lubricate the gasket in the neck of the discharge valve, replace the discharge valve and pickup tube, and apply the proper air pressure (100 psi, 7 kilograms per square centimeter).

d. The extinguisher must be hydrostatically tested every 5 years.

2-22. Soda-Acid Extinguishers

In the 2½-gallon (9.46-liter) soda-acid extinguisher (fig. 2-54), water is the extinguishing agent, and a chemical combination generates enough pressure to discharge the water. The tank contains a solution of sodium bicarbonate and, supported in the top of the reservoir, a glass bottle containing 4 ounces (118 milliliters) of sulfuric acid. When brought together, these two chemicals produce carbon dioxide gas, which expels the water. A loose stopper in the mouth of the acid bottle retards the absorption of moisture by the acid. When the extinguisher is turned upside down, the loose stopper falls partially clear of the acid bottle and allows the contents of the bottle to mix with the soda solution. The taper of the stopper regulates the flow of acid and prevents sudden nigh pressures. The rate of flow insures chemical reaction of all the acid before the solution is discharged from the extinguisher. The soda-acid extinguisher also has a hose and nozzle and a tnreaded cap which cotains the necessary gasket.

a. To operate the 2½-gallon (9.46-liter) soda-acid extinguisher, grasp the nozzle and invert the extinguisher. The chemical reaction and pressure occur almost immediately after tilting, causing discharge of the agent.

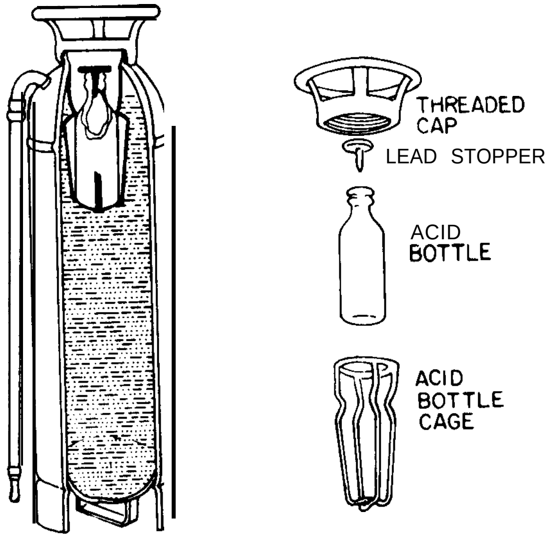


Figure 2-54. Soda-acid extinguisher.

b. The monthly inspection of the soda-acid extinguisher includes checking the hose and nozzle for obstruction, removing the cap to assure the presence of the proper agent, and recording the entry on the extinguisher tag. The annual inspection requires discharging, cleaning, and recharging the tank.

c. To recharge the soda-acid extinguisher remove the cap, acid bottle, and bottle cage ; wash all parts thoroughly; and check to see that all of the liquid is removed from the acid bottle before water or acid is added. Dissolve 1½ pounds (0.68 kilogram) of bicarbonate of soda in '7 quarts (6.5 liters) of lukewarm water. Pour the solution into the extinguisher and add fresh water to the level of the special marker on the inner wall of the extinguisher. The extinguisher when filled to the top of the collar holds 3 gallons (11.4 liters), but it must never be charged with more than 2½ gallons (9.46 liters) of liquid. Pour 4 fluid ounces (118 milliliters) of concentrated sulfuric acid into the bottle. A plainly etched line in the bottle shows the 4-ounce (118-milliliter) level. Insert the lead stopper in the acid bottle and place it in the cage; then insert the cage and bottle in the extinguisher. Be certain that the cage, bottle, and stopper are those made for that particular extinguisher. Manufacturers are not necessarily standard in the shaping of their extinguishers, and many of the parts are not interchangeable. Next examine the gasket in the cap. Replace the gasket with a new one if it is rigid or defective. Finally screw the cap down hand-tight on the collar. See TM 5-687 for further details.

d. The soda-acid extinguisher must be hydrostatically tested every 5 years.

e. The soda-acid extinguisher has been taken out of TB 5-4200-200-10, and therefore, thas been discontinued as Army issue equipment. The pump type water extinguisher is taking its place.

2-23. Foam Extinguishers

The 2½-gallon (9.46-liter) foam extinguisher illustrated in figure 2-55 is similar in size and appearance to the 2½-gallon (9.46-liter) soda-acid extinguisher, but it differs in internal construction, extinguishing agent, and charging procedure.

CL. This type extinguisher consists of an inner chamber and an outer chamber. The outer chamber contains a solution of sodium bicarbonate, and the inner chamber contains a solution of aluminum sulfate, Ingredients added to the soda solution assist in forming and stabilizing the foam. The extinguisher is operated by inverting it, allowing the contents of the two chambers to mix. This reaction produces bubbles containing carbon dioxide gas, with the stabilizing ingredients strengthening the bubble structure and producing foam. This foam is expelled from the extinguisher by the carbon dioxide gas pressure.

b. To operate the extinguisher, simply grasp the hose, invert the extinguisher, and direct the foam at the base or forward part of the flame. Allow

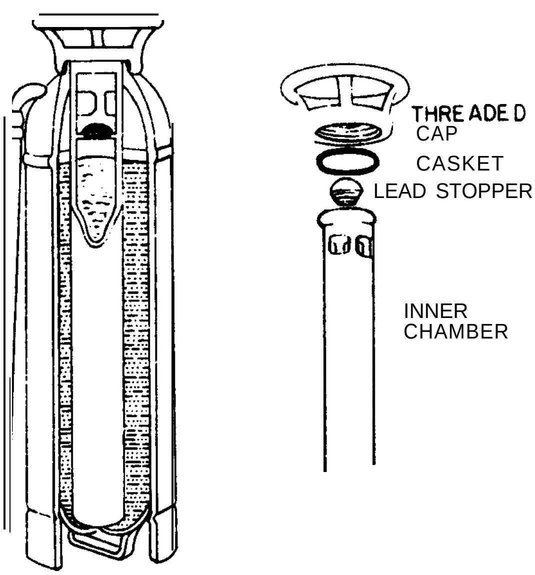


Figure 2-55. Foam extinguisher.

the foam to flow over the surface of the fire area as a smothering blanket.

c. The monthly inspection of the foam extinguisher includes carefully examining the nozzle for stoppage, since the contents of the extinguisher frequently plug the nozzle; inspecting the hose and tank for deterioration; and checking for the proper amount of fluid by weight or internal observation. On the semiannual inspection, perform the monthly services and also check the inner chamber for corrosion by removing the cap. Replace the inner or outer chamber, if required. Check the inner chamber stopper for freedom of movement and look for gasket breaks or deep grooves worn by the filler collar. Replace the gasket in the cap, if necessary. Examine the filler collar for dents and for the presence of foreign matter. The annual inspection includes all of the preceding services plus the discharging and recharging of all foam extinguishers. See TM 5-687 for further details.

d. To recharge the 2½-gallon (9.46-liter) foam extinguisher make sure that the two solutions are in accordance with the instructions printed on the chemical containers. Usually the chemicals are in two containers marked "A" and "B". The solutions should be prepared in separate containers. In the absence of such instructions, dissolve the contents of package "A" in exactly 2¼ pints (1.064 liters) of hot water and pour it into the inner chamber. Dissolve the contents of package "B" in exactly 1¾ gallons (6.624 liters) of lukewarm water and pour this solution into the outer chamber. Do not use hot water with the contents of package "B" because it deteriorates with heat. Place the stopper in the inner chamber and assemble the extinguisher.

e. The foam extinguisher should be hydrostatically tested every 5 years.

f. The foam extinguisher has been discontinued as Army issue equipment. The ones in use will be phased out in time.

2-24. Bromotrifluoromethane Extinguisher (Vaporizing liquids)

The CF3Br extinguisher, figure 2-56, commonly known as FREON 1301, contains a liquefied compressed gas which offers unusual advantages as a safe and efficient fire extinguishing agent particularly against Class B (flammable liquid) and Class C (electrical) fires. The liquid has a boiling point of —72°F. (—56.8° C.), and a freezing point of —270° F. (-167.78' C.).

Figure 2-56. CF_3Br extinguisher.

a. CF_3Br is not toxic in its natural state. Decomposition occurs at fire temperatures and the products of decomposition are toxic. These products are injurious if they exceed 10 percent of the air volume. Normally, extinguishment can be accomplished with less than 5 percent per volume of air. It should be used with caution in confined spaces. CF_3Br decomposes partly when subjected to heat and flame, which causes a decrease in its toxicity limits. CF_3Br is noncorrosive on metals and alloys, and is considered a clean agent.

b. The only CF_3Br extinguisher in the Army inventory is of the 2¾-pound (1.25-kilogram) size, which has the same extinguishing ability as the 5-pound (2.27-kilogram) CO_2 unit.

c. Because of the low vapor pressure of CF_3Br at ambient temperatures, the extinguisher is pressurized to 400 psi (28 kilograms per square centimeter) with nitrogen. This pressure is sufficient to permit use of the extinguisher at —65° F. (—54° C.) without further modification.

d. The CF_3Br extinguisher must be kept fully charged at all times. Reweighing is the only method of determining whether or not the extinguisher is fully charged. The extinguisher should be weighed semiannually on an accurate scale to determine leakage. The cylinder assembly must be replaced if it has lost more weight than is permitted by the instructions on the extinguisher nameplate. Recharging is necessary if the weight is found to be 10 percent deficient. The date of recharging should be stenciled on the cylinder.

e. Where extinguishers of this type are used, charged cylinder assemblies should be kept on hand so the extinguisher may be promptly recharged after use.

f. These extinguishers should not be located where the ambient temperature will exceed 150° F. (65° C.).

2-25. Dry Chemical Extinguishers

Dry chemical portable fire extinguishers vary from 2½ pounds to 150 pounds (1.134 kilograms to 68 kilograms). The dry chemical compound used consists principally of bicarbonate of soda or potassium bicarbonate or ammonia phosphate which has been treated to make it waterproof and free flowing. The extinguishing action of this agent is to smother the fire.

a. Dry chemical extinguishers are of two basic types. One type is pressurized with 150 psi (10.5 kilograms per square centimeter) of dry nitrogen or dry air, and the other has a cartridge with CO_2 under pressure. When the cartridge of the second type is punctured, CO_2 pressure expels the agent (fig. 2-57).

b. To operate the pressurized dry chemical extinguisher, break the sealing wire, remove the locking pin, depress the operating handle, and direct the agent at or close to the base of the fire. To operate the cartridge dry chemical extin-

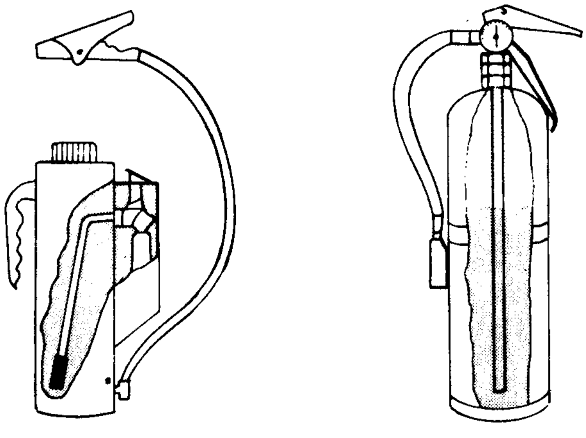


Figure 2-57. Dry chemical extinguisher.

guisher, break the sealing wire, remove the locking pin, depress the cartridge-puncturing handle, and direct the agent at or close to the base of the fire.

c. When performing a monthly inspection, check the sealing wire and seal, the dry nitrogen pressure gage for the correct pressure of 160 psi (10.6 kilograms per square centimeter) (pressurized type), and the hose and nozzle for foreign objects. The semiannual and annual inspections compare with the monthly inspections, with the one exception that the cartridge of the nonpressurized extinguisher must be weighed during the annual inspection. If the weight of the cartridge contents (as stamped on the cylinder) is 10 percent or more below the prescribed weight, the cartrdige should be replaced. See TM 5-687 for further details.

d. The dry chemical extinguisher should be hydrostatically tested every 5 years.

2-26. Combustible Metal Agents

Two extinguishing agents are listed for use on Class D (combustible metal) fires. They are available in drums or barrels and put on the fire with a scoop or shovel. A cover of at least ½ inch (1.27 centimeters) of extinguishing agent is applied to the burning agents. The two agents are:

*a. G-l **Powder.*** This is screened graphitized foundry coke with various phosphates added. It includes particles of various sizes to aid in packing. The material acts as a heat conductor to lower temperature of the burning metal and forms a coating to smother the fire by excluding air. It also produces a gas to aid in smothering. It may be used on magnesium and magnesium alloy fires.

b. Met-L-X Powder. This has a sodium chloride base with additives to give water repellancy and good flow characteristics. An additive fuses at high temperatures to aid in forming an airtight coating. This material forms a coating to exclude air, which smothers the fire. It also conducts some heat away from the burning metal. It may be used on magnesium, sodium, potassium, and sodium-potassium alloy (NaK) fires.

2-27. Dry Power Extinguishers for Combustible Metal Fires

a. Dry powder extinguishers also use the Met-L-X sodium chloride dry powder described in the preceding paragraph. It is dispensed with a 30-pound (13.6-kilogram) capacity extinguisher (fig. 248). This amount of rated D agent is effective on about 6 pounds (2.7 kilograms) of burning metal, depending on the type and form of the metal. Only cartridge-operated units are available. The dry powder extinguisher is operated by removing the hose which is around the puncturing mechanism, then depressing the plunger which punctures the cartridge. The compressed gas in the cartridge is released into the shell, thus pressurizing it. The gas pressure expels the dry powder from the shell when a nozzle shutoff is opened. This pressurizes the shell. The extinguisher is carried by its handle with one hand and the nozzle and shutoff valves are operated with the other hand. The shutoff valve is squeezed to open it and released to stop the flow of the agent. The normal operation is to open the nozzle partially to obtain a soft flow of the agent. The burning metal is covered with at least one ½ (1.27 centimeters) of the Met-L-X sodium chloride. If glowng spots appear, they should be recoated. The application of this agent forms a crust over the burning metal which excludes the air and thus smothers the fire. The effective range of the extinguisher is from 3 to 5 feet *(0.9* to 1.5 meters).

b. The dry powder extinguisher should be recharged after each use. First, the gas pressure is released by turning the extinguisher upside down and opening the shutoff valve. This will not release the agent remaining in the extinguisher. Next, the extinguisher is disassembled according to the manufacturer's instructions and cleaned

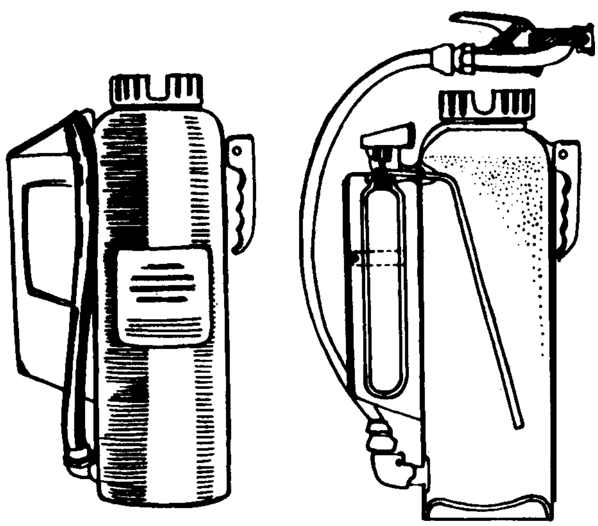


Figure 2-58. Exterior and cutaway views of a dry powder extinguisher.

with a brush or compressed air. Then the shell is filled with the proper amount of dry powder. In reassembling, check the gasket, insert a new cartridge, seal the extinguisher, and tag it.

c. The monthly inspection includes checking the nozzle, the hose, the shell for defects, and the seal to assure that it has not been broken. The annual inspection requires a thorough check of all component parts and the weighing of the cartridge on an accurate scale calibrated in fractions of an ounce (or grams). The cartridge is replaced if it has lost ½ ounce (14 grams) or more. A hydrostatic test must be performed on the extinguisher shell and the hose every 5 years.

d. Do not confuse tthe dry powder extinguisher with the dry chemical type extinguisher.

2-28. **Winterization of Extinguishers**

The protection of fire extinguishers krom freezing is extremely important and should be thoroughly understood by all fire protection personnel.

a. Carbon dioxide extinguishers which must be operated in temperatures below 0° F. (17.8' C.) must be winterized. This winterization is essential because when the temperature falls below 0° F. (17.8° C.), the pressure of the extinguisher also falls below 285 pounds per square inch (20 kilograms per square centimeter), which is the minimum amount of pressure needed for proper operation. The winterization of CO_2 extinguishers requires the addition of 200 pounds (90.7 kilograms) of pressure per square inch (14 kilograms per square centimeter), which is done by adding dry nitrogen to the CO_2. Local directives should be consulted as to the amount of dry nitrogen to be added. The addition of dry nitrogen requires a decrease in the amount of CO_2 in the cylinder. The dry nitrogen provides additional pressure for expelling CO_2 at low temperature. Since the decrease of the CO_2 will not allow the addition of dry nitrogen pressure to rupture the cylinder gravity disk until the temperature reaches 160° F. (71° C.), the injection of dry nitrogen allows the extinguisher to operate in temperatures higher than in those permitted by CO_2 gas, as well as in temperatures lower than in those permitted by CO_2 gas.

b. The prescribed chemical for lowering the freezing point of water in water-type extinguishers is calcium chloride. The quantity of calcium chloride required to prevent freezing will vary from 3 pounds per gallon (0.362 kilogram per liter) of water to protect against a temperature of 2° F. (-16.9' C.), to a maximum of 5 pounds per gallon (0.6 kilogram per liter) of water to protect against a temperature of —53° F. (—47° C.) (TM 5-687). Local directives should be consulted for specific amounts at each temperature level. Before winterization, extinguishers which require the use of calcium chloride solutions should have the interior of the water tank painted with two coats of asphaltum base paint to retard corrosive action. Dry calcium chloride should not be placed directly into the appliance to be winterized. The chemical should be mixed with water in a separate container to prevent caking at the bottom of the tank. A ¼ ounce of sodium bichromate added to each gallon (1.87 grains per liter) of water will act as a rust inhibitor. Do not antifreeze pressurized water extinguishers with calcium chloride. Use specially prepared solution.

c. Since soda-acid and foam extinguishers depend on a chemical reaction to expel the extinguishing agent, winterizing chemicals are not used. Therefore, soda-acid and foam extinguishers are normally located only in heated structures.

d Pressurized dry chemical extinguishers do not require winterization. Cartridge type dry chemical extinguishers are winterized by replacing the CO_2 filled cartridge with one filled with dry nitrogen.

NOTE

See TB 5-4200-200-10 for hand portable fire extinguishers approved for Army users.